dust-cloud. The spots observed on Jupiter's surface are next dealt with, a table of their rotation periods and latitudes being included. From the latter he deduces that the mean periods of rotation of matter in the following latitudes are:—

Lat.		h.	m.	s.
12° N.	from 17 N. Temp. spots	9	55	36·49
4° N.	,, 5 N. Equat. ,,	9	50	40·06
8° S.	,, 21 S. Equat. ,,	9	50	22·4
30° S.	,, 3 spots	9	55	17·1

In treating of the spots themselves, he suggests that those which are of a white appearance are gyrating uprushes of warm air from the lower regions, while the dark ones are simply descending columns of cool air, "the two forming parts of the system of vertical circulation." The red spot, he suggests, is caused by a local escape of internal heat, the repellent force it appears to possess being due to the "spreading of the heated currents as they rise." He explains the retardation and acceleration of its period of revolution by the increasing force of the west winds, brought about by the exposure of the southern hemisphere during Jupiter's half-year (5·93 of our years); in this way the spot is sometimes situated over and sometimes to one side of the source of heat underneath. The author also deals with other spots in a similar manner.

GEOGRAPHICAL NOTES.

MR. SVEN HEDIN's account of his ascent of Mount Demavend is published in the last number of the *Verhandlungen* of the Berlin Geographical Society. Demavend is a volcanic peak rising abruptly from the sedimentary rocks of the parallel Elburz chains. Starting from the village of Ranah on the south-eastern slope with two guides on July 10, 1890, Hedin reached the summit on the afternoon of the next day. On the summit a large elliptical crater was found; the edges of which were strewn with blocks of porphyritic lava and sulphur. After discussing the aneroid and boiling point observations, Mr. Hedin arrived at 5465 metres (17,930 feet) as the height of the summit. This is lower than any of twelve earlier estimates which are cited, the highest of them being 6559 metres.

THE Italian possession of Eritrea on the coast of the Red Sea gives some promise of becoming useful agriculturally. Several small settlements of Italians on the plateau have succeeded in growing large crops of wheat and barley, and only the unsettled state of the surrounding natives threatens the prosperity of the farmers. The districts of Oculé-Cusai and Guro are already fully cultivated, and Saraé, as yet almost unoccupied, has fertile land and plenty of room for colonists. The Italians are able to work in climatic conditions which would rapidly exhaust the natives of northern Europe.

THE general summary of Mr. Conway's expedition in the Karakoram range telegraphed from India (p. 525) has now been supplemented by a full narrative, written to the secretaries of the Royal Geographical Society from a camp on the Baltoro Glacier on August 29, with a postscript added at Skardo, on the way to Leh, on September 12. The difficulties of the preliminary journey were very great, not the least being the fording of several swollen glacier streams by a party numbering four Europeans, four sepoys, seventy coolies, an indefinite number of followers, and flocks of goats and sheep. The moraines on the Baltoro glacier were of almost incredible extent; for two-thirds of its entire length the ice is entirely concealed by stones, except where crevasses or lakes occur, and the irregularity of the surface made travelling extremely slow. Mr. Conway limits the name of Godwin-Austen to the highest peak of "K^2," giving to the whole mountain the somewhat cumbrous title of the Watch Tower of India. One branch of the Baltoro Glacier results from the union of seven glaciers from this mass; the larger branch descends from the snow-swathed, throne-shaped mountain, hitherto unmapped, for which the auriferous quartz found in its rocks suggested the name of The Golden Throne. This was fixed upon as the goal to be attained. The first attempt landed the Europeans and Ghoorkas, who made excellent climbers, on Crystal Peak, 20,000 feet in elevation, a peak as hard to climb as the Matterhorn, and isolated from the surrounding higher summits. No inconvenience was felt from the rarity of the air, and the party remained on the summit for an hour and a quarter. In the grand attempt on the Golden Throne serious difficulty was encountered from the terrible extremes of heat and cold. The last few thousand feet proved very exhausting; one of the Ghoorkas had to be left behind, suffering from mountain-sickness. Every step had to be cut in hard ice. Finally the summit was reached at an elevation of 23,000 feet; but the Golden Throne stood revealed much higher, and separated by a deep depression. From the summit of Pioneer Peak, probably the highest yet reached by man, a series of photographic views was obtained and prismatic compass bearings taken to the surrounding features. As long as the party were at rest they felt no discomfort, but the sphygmograph showed that the heart's action was very laboured. A stay of an hour and a quarter was made on the summit, the view from which baffled description. The descent was safely made, but fatigue and bad weather stopped further exploration.

THE INSTITUTION OF MECHANICAL ENGINEERS.

ON the evenings of Wednesday and Thursday of last week, the 26th and 27th ult., an ordinary general meeting of the Institution of Mechanical Engineers was held in the theatre of the Institution of Civil Engineers, by permission of the council of the latter Society. The President, Dr. William Anderson, occupied the chair during the proceedings.

There were two papers on the agenda. The first was the report of the Institution's committee appointed to enquire into the value of the steam jacket. Mr. Henry Davey is the chairman of this committee, and he had prepared the report; which is a bare record of facts without comment, and in this respect is, we think, defective. Numberless experiments have been made in time past as to the value of the steam jacket, and those now added by the labours of the committee do not largely differ from many that have gone before. We take it that the general opinion of competent engineers is that an advantage in efficiency is to be obtained by jacketing engine cylinders in an efficient manner, and cases in which the jacket has not been proved efficient are those in which it has not been properly applied. What was wanted, therefore, was guidance as to the proper method of application, and it is significant that the most help in this direction came, during the discussion, from those who were not members of the committee. Timidity in expressing opinion will be excusably construed as indicating something of incompetence, and if the members are not capable of expressing opinion they are not suitable persons to form a research committee of an important institution. We frame our remarks hypothetically, because, with such names as Unwin, Bryan Donkin, and Mair-Rumley on the title-page, there can be no doubt that the power to afford guidance was present, and for this reason the decision to give only bare fact is the more to be regretted. The general conclusion to be drawn from the experiments, as quoted, is that "the expenditure of a quantity of steam in an efficient jacket produces a saving of a greater quantity in the cylinder." It does not follow from this that the jacket is always desirable, as the saving may be so small as not to justify the additional complication and increased outlay at first cost. That, however, is a matter upon which steam users must themselves decide upon a commercial basis; and is, of course, outside the province of the committee, but what would have been valued would have been some critical remarks giving guidance as to what goes to constitute the "efficient jacket," what fresh engineering practice is opened up by the use of the efficient-jacket, and under what conditions it may be most effectually applied.

The first series of experiments quoted were carried out by Mr. J. G. Mair-Rumley, of the firm of James Simpson and Co., of Pimlico, upon a compound jet-condensing beam pumping-engine. The diameters of the cylinders are 29 inches and 47·5 inches, with strokes of 65·1 and 96 inches respectively. Only the body of each cylinder is jacketed, the steam being supplied direct from the boiler at a pressure of 49lbs. per square inch above atmosphere. Experiments were made both with and without steam in the jackets. The total feed water per indicated horse power per hour when the jackets were not in use was 18·20lbs., with the jackets in use the corresponding figures were 16·64 lbs., thus showing a percentage of less steam used due to the jackets of 8·6. The quantity of jacket water condensed was 1·20 lbs. per I.H.P. per hour. The boiler pressure here was not high, 49·7 lbs. without and 49 lbs. with jackets.

The number of revolutions were also low, 14·8 without jackets and 15·78 with jackets. This was evidently an engine which should pay for jacketing. We next come to an experiment of a different nature, carried out by Mr. Davey and Mr. W. B. Bryan. The engine is triple expansion surface-condensing engine of the inverted direct-acting marine type, and is placed in the Waltham Abbey pumping station of the East London Water Works. The cylinders were 18″, 30·5″, and 51″ in diameter, by 36 inches stroke. There is a Meyer expansion valve to the high pressure cylinder, by means of which the speed of the engine was regulated during the experiment. The bodies and both ends of all three cylinders are steam-jacketed. The jacket steam of the high pressure cylinder is at full boiler pressure, but the other two cylinders have the pressure reduced to a little above that of their steam-chests by means of reducing valves. Each cylinder is therefore jacketed with steam a little above its own initial pressure. Without the jackets in use the amount of feed water per I.H.P. per hour was 17·22 lbs, and with the jackets in use 15·45 lbs, showing a percentage of less steam used owing to the jacket of 10·3. The total jacket water was 1·72 lbs. per I.H.P. per hour. The coal consumption is given in these experiments, being 2·09 lbs. per I.H.P. per hour without the jackets, and 1·79 lbs. with. The amount of coal burnt is not, of course, necessarily a measure of economy of the engine, but possibly the steam-generating plant —which included an economizer—was practically constant in its duty during both trials, and if so the commercial gain by the use of the jacket is quite an appreciable quantity. The boiler pressure here was 130 lbs. above atmosphere, the number of expansions without the jacket 22, and with the jacket 30. The revolutions were 23 per minute, so that the jacket had again a favourable chance.

The next series of experiments were carried out by Colonel English, Mr. Davey, and Mr. Bryan Donkin, and in these we reach a much higher piston speed, so that the results stand on a somewhat different footing in this respect to those before quoted. We have no positive knowledge of this engine beyond that given in the report, but it would be desirable to know something more of its working before accepting the very high percentage of gain in steam used—19·0 per cent.—as that due to a steam jacket used on a good engine. The feed used per I.H.P. per hour was 24·68 lbs. without the jacket, and with the jacket in use the quantity was 20 lbs. The following are the particulars of this trial :—Horizontal surface condensing compound engine, with intermediate receiver cylinders, 18 and 32 ins. by 48 ins. stroke. The ends of the cylinders are not jacketed, and the receiver jacket was not in use during the experiment. The boiler pressure was 50 lbs., the revolutions 57·06 without jackets, and 63·62 with, the feed water supply as stated, and the jacket water condensed per I.H.P. per hour 1·13 lbs. The coal used without jackets was 3·26 lbs. per I.H.P. per hour, and with jackets 2·66 lbs.

The last set of experiments we shall quote were made by Prof. Unwin, upon the experimental engine[1] at the City and Guilds of London Central Institution, South Kensington. It is a two-cylinder horizontal-surface condensing engine, and can be worked either simple or compound. The cylinders are 8·73 inch and 15·76 in diameter, by 22″ stroke. The high pressure cylinder is fitted with Hartnell expansion gear, and the low pressure with Meyer expansion gear. Only the bodies and the back ends of the cylinders are covered. We will first give results of trials working the engine with the low pressure cylinder only. The pressure was 60 lbs. above atmosphere, the jacket pressure being taken direct from the boiler. The revolutions without the jacket were 112·40, and with the jacket 101·73. The feed water per I.H.P. per hour without the jacket was 32·14 lbs., and with the jacket 26·69 lbs. This gives a saving of 17 per cent. working simple. It will be seen presently that when the engine was working compound, the saving was 7·3 per cent. The jacket-water per I.H.P. per hour was 1·88 lbs. We will now take the records of the compound trial. The boiler pressure was 66·73 lbs. without the cylinders, and 67·80 lbs. with the jackets. The revolutions were 93·66 without the jacket, and 96·11 with. The feed water used per I.H.P. per hour was 21·06 lbs. without the jackets in use, and 19·52 lbs. with. The saving, as stated, made by the use of the jacket was therefore 7·3 per cent. The jacket water used per I.H.P. per hour was 2·40 lbs. We regret we are not able to give all the interesting details which Prof. Unwin includes in his instructive report, but for these we must refer our readers to the original paper.

Probably Prof. Unwin's 7·3 per cent. saving in steam used is a far better measure of the value of the jacket than the inflated promise of 19 per cent. in Major English's trial. It should be remembered that the jacket is more effective in small than in large engines, the area of cylinder will be in a higher ratio to the contained steam in the former than in the latter case. The number of expansions in the South Kensington engine working without jackets was 7·23, and with jackets 9·29. The corresponding figures in the case of the Woolwich engine were 9·4 and 12·6. The boiler pressure with the Woolwich engine was, however, 16 to 17 lbs. higher than in the other case. The revolutions were 57·06 and 63·62 respectively in the two trials at Woolwich, whilst at South Kensington they were 93 66 and 96·11. It would have been instructive if the committee had had the courage to attempt some balance of these figures, and then have endeavoured to account for the large difference which we believe would have remained still to be accounted for.

The next experiments quoted comprise a series made by Mr. Bryan Donkin, junr., at the works of his firm at Bermondsey. Mr. Donkin's labours in this field are well known, and engineering science is largely indebted to him for the contributions he has made to its lore. One most valuable feature in connection with these investigations is the means he has used to ascertain the temperature of the walls of the cylinder at various distances from the surface. In this lies the essence of the problem. If the Jackets Committee would give us minute and trustworthy information on this point we could evolve the rest from existing data. If we do not quote Donkin's figures in full it is partly because his experiments are not yet complete and partly because they have been dealt with more fully in "another place," namely, the Proceedings of a Society other than tha with which we are now dealing. We may state, however, that in one case when the steam in the jacket space was 298° Fahr. the cylinder walls averaged 290° Fahr., whilst at 0·06 in. from the piston the temperature of the cylinder wall was 284° Fahr. These temperatures were ascertained by thermometers placed in holes drilled in the cylinder. Other instances are given, but the matter is far too interesting to deal with in a cursory manner, such as a report of this nature alone warrants. The difficulty that suggests itself is the fact that a thermometer itself has a very appreciable thickness, and the record will be but a mean of the temperature due to that thickness. It is possible that Mr. Donkin gets over this difficulty in some way. Perhaps the thermo-couple as used by Le Chatelier might afford a solution, although this [apparatus is not so useful for recording small differences at low temperatures, being rather adapted for such work as hot blast stoves and other metallurgical purposes. Mr. Bryan Donkin's experiments are the most suggestive in the report, as might be anticipated. Trials were made with steam at various rates of expansion to determine the effects of the steam-jacket on the speed of engine and temperature of the cylinder walls, and on superheating. The engine used was a small one (6″ × 8″), but it was specially constructed and arranged for the work. We again repeat Mr. Donkin's investigations are well worthy of the study of all interested in these matters.

The report concludes with a valuable appendix in the shape of suggestions for the use of those desirous of experimenting in this field.

The discussion on this paper was of a protracted nature, but was not of a kind altogether worthy of the leading mechanical institution of the country. Mr. Morrison, of Hartlepool, made the most weighty contribution amongst the speakers. He pointed out the difficulty of maintaining a good circulation of steam in the jacket—one of the most important points to which the designer of jacketed engines should turn his attention—and illustrated a simple method by which he had secured this end. His arrangement consisted of a series of diaphragms, by means of which the steam was made to take a devious course through the jacket. Mr. Schonheyder pointed out a mistake the committee had made in placing an air-cock on the top of the jacket, when it was required to draw off air from the steam. Of course, this is one of those little slips which the wisest are apt to make, for it would be absurd to suppose such authorities as those engaged did not know that air is heavier than steam. One might as well say one's grocer did not know sand from sugar.

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[1] This engine is stated in the report to have been fully illustrated and described in *Engineering* of November 16, 1888. The triple expansion engine at Waltham Abbey is also said to have been illustrated and described in the issue of August 8, 1890, of the same publication.

[1] See Proceedings Inst. Civil Engineers.

The Jackets Committee has not yet concluded its labours, and another report will be forthcoming in due course. Mr. Aspinall has offered a locomotive for trial, and we heard that Mr. Yarrow will put a torpedo boat at the disposal of the committee, and has even promised to cast special cylinders for experimental purposes. The locomotive will afford an interesting field of research, running as it does so largely linked up. The torpedo boat experiments will be no less interesting, especially in view of the great number of revolutions the engines of these craft make in a given time.

On the second day of the meeting the paper by Mr. Walker of Bristol on the screw propeller. This paper gives the details of some experiments made by the author on a form of screw propeller invented by the late Mr. B. Dickinson. It would be in vain for us to attempt to condense this paper within the limits at our disposal. With regard to the merits of the Dickinson propeller we have nothing to say. It consists essentially of two narrow blades in place of one, and reminds us strongly of a Mangin propeller with one blade set somewhat back on the shaft. Mr. Walker contends that his researches prove the advantages of long narrow blades, but he did not appear to have converted the high authorities present, including Mr. Froude, Mr. Thorneycroft, and Mr. Barnaby—the three best-known names in connection with the subject—to his views. It is difficult to see wherein the value of the paper exists. Prof. Kennedy in the discussion stated that the generally received opinion as to the increase of the friction of the load was erroneous, and that the power absorbed in this way does not increase in the manner stated, a fact which he illustrated by means of a diagram. Mr. Thorneycroft pointed out that "life was not long enough" for the larger trials proposed by the author, but that he might decide one point if he would confine himself to models. Mr. Barnaby stated that a broad-bladed propeller should not be a uniform pitch. Mr. Froude's speech was a lucid criticism of the author's paper, the speaker pointing out in a kindly but convincing manner that the conclusions arrived at by the author might be subject to revision. Mr. Dunell, whose previous experiments the author had quoted, added to the information given by putting forward some other experiments he had made upon screw propellers fitted to a torpedo boat, in this case the results being opposed to those claimed by the author, inasmuch as the shorter and broader blade had proved the more advantageous. Mr. Shield, of Liverpool, described a form of propeller which has been in use on the Mersey, and appears to offer some advantages. The blades are attached to the boss in two parts, and are joined in a loop at the top. According to Mr. Shield's statement, the arrangement gives great advantages in towing, and also increased steadiness in running. The latter we can accept as a fact, but the great increase in towing capacity seems almost too good to be accepted literally. Twenty-five per cent. additional efficiency is a very large gain without further expenditure than an exchange of screws; but this is what the propeller in question is said to realize.

The meeting concluded with the usual votes of thanks.

INTERNATIONAL COMMITTEE OF WEIGHTS AND MEASURES.

THE International Committee of Weights and Measures, which was established in consequence of the Metric Convention of 1873, has recently issued its fifteenth annual report to the Governments represented at that Convention.[1] The committee have also lately published the minutes of their proceedings (Procès-Verbaux des Séances. Paris, 1892. 1 vol. 8vo) at the annual meeting held at Paris in September, 1891. It appears to be hardly possible that the proceedings of the committee at their meeting which was held last month may be issued before next year, but from the above publications, as well as from a recent volume of their "Travaux et Mémoires," we gather that they continue to carry on their investigations with all despatch.

In their last report the committee deplore the death of their colleague, Jean-Servais Stas, whose analyses of the platinum alloys have, together with those of St. Claire Deville and George Matthey, so largely helped forward the principal work of the committee; the metallurgical studies of Stas are indeed recognized as veritable models of classical research in this particular field.

The new instruments added to the Bureau at Sèvres during the last year include a normal barometer (le Baromètre Fuess) and manometer, originally verified for reference as an international standard in accordance with the decisions of the Meteorological Conferences, particularly that at Munich last year. The committee have also obtained a new apparatus for determining the normal thermometric "boiling point," or the temperature of 100° Centigrade, as it has been found that the form of apparatus used by Regnault was unreliable for this purpose. In the reading of the standard manometer it would appear that higher accuracy has been obtained by raising the surface of the mercury up to a fixed point, the image of the point in the mercury being observed at the same time by means of a microscope. The Wild-Pernet barometer has been remounted, and the Bureau are now prepared to undertake the verification of any standard barometer.

The readings of all mercurial thermometers are given at the Bureau in terms of the hydrogen thermometer; and a 30-litre holder for methyl chloride, or liquid carbonic acid, has been made by Brigonnet and Navile. The low temperature experiments have been continued by M. Chappuis down to —75° Cent.; and toluol and alcohol thermometers have been compared with the hydrogen thermometer. It has been found that "toluol" is more sensitive and reliable for low temperatures than alcohol.

We note that the meteorological work of the committee has largely developed itself; and that, as in geodetic research, the Bureau at Sèvres is now recognized as a central and international station of reference. Standard thermometers have been verified, for instance during 1892, for the Governments of Russia, France, and Roumania; for the Universities of Rome, St. Petersburg, and Odessa; for Owens College, Manchester; and for several recognized meteorological observatories. Great Britain has also been supplied by the committee with standard thermometers similar to those supplied to other contracting States.

Besides the standard metre and kilogramme already delivered to this country, the Bureau is undertaking the construction of a further standard metre for the Board of Trade, at a cost of 12,588 francs. The new standard appears to have been nearly two years in construction, but its verification is now promised this year.

There are twenty-one different governments who have joined the Convention and who contribute annually towards the expenses of the Bureau (the annual budget of which is 75,000 francs), sums varying from 134 francs (Denmark) to 9482 francs (Germany) the annual contribution of Great Britain and Ireland for 1892 being stated at 4699 francs, or nearly £188; and that of the United States at 8471 francs.

At the instance of Dr. B. A. Gould the committee are now also undertaking an inquiry affecting measurement by light waves. By the use of the "Refractometer" Dr. Michelson found (*Philosophical Magazine*, April, 1891, and September, 1892) that accuracy of measurement by light-waves may be increased to a high degree of accuracy. By the best spectroscopic instruments now in use it has been stated to be difficult to "resolve" lines as close together as the components of the yellow sodium lines, but that if the width of the lines themselves be less than their distances apart, then there is no limit to their accuracy of measurement by the "Refractometer." We shall look forward with interest to the publication of Dr. Michelson's further results, in the next volume of the "Travaux et Mémoires" of this committee.

The new instrument designed by M. Gustave Tresca, of the Conservatoire des Arts et Metiers at Paris, for the adjustment and polishing of the terminal surfaces of end-measures of length appears also to be better than anything yet adopted in England.

The committee not only undertakes the verification of standards and instruments for the High Contracting Governments (who have the right to demand such verifications), but they also verify for any scientific authorities or persons. To those of our readers, therefore, who may desire to have standards or instruments verified by the committee, the following information may be useful:—

Applications for the verification of instruments should first be made to M. le Directeur du Bureau International (Dr. René-Benoît), au Pavillon de Breteuil, Sèvres, près de Paris.

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[1] Rapport du Comité International. Gauthier-Villars. Paris. 1 Vol. 50 pp., 1892.